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Cultural Modeling Support to Pakistan-Afghanistan (PAKAF) Strategic Multi-Layer Assessment (SMA)

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ABSTRACT: *The U.S. Army TRADOC Analysis Center (TRAC) in Monterey implemented a prototype agent-based modeling capability to analyze population stances and behaviors. The analysis focused on three issues for six Helmand Province districts in Afghanistan: Kajaki, Sangin, Gereshk, Lashkar Gah, Nawa, and Garmsir. The three issues under study were population stances on security, infrastructure, and governance. The research utilized a multi-faceted approach to analysis of operations in Helmand Province based on district, political affiliation, family status, tribal affiliation, urban/rural disposition, and age. The approach enables analysis to identify which population groups are most significantly impacted due to events and behaviors, such as the amount of ISAF non-kinetic operations. Similarly, it enables identification of which actions, such as kinetic actions by either ISAF or insurgents, would result in negative impacts to security stances for all modeled population groups. The modeling approach uniquely utilizes many population attributes, providing a rich and contextual examination of the operational environment. (Findings are not to be construed as an official Department of the Army (DA) position unless so designated by other authorized documents.)*

1. Introduction

The United States Military has developed several physics-based models to investigate possible futures and landscapes of outcomes of traditional warfare. Irregular Warfare is defined as the struggle "for legitimacy and influence of the relevant populations" [1]. However, there are currently no widely adopted, validated, social science based models available to represent the behavior of populations. In order to address this shortfall, the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC), in Monterey (MTRY), California, developed the Cultural Geography (CG) model. Implementing several social science theories, the CG model is an Agent-Based Model (ABM) created to investigate the response of the population within the conflict eco-system described by Kilcullen [2].

In January 2010, the Irregular Warfare study team at TRAC-MTRY completed work on a CG scenario associated with the Pakistan-Afghanistan (PAKAF) Strategic Multi-Layer Assessment (SMA), part of a larger effort to gain a rich contextual understanding of the current conflict environment. The scenario is unclassified and based on six districts in the Helmand Province in Afghanistan. The model has a representation of the population, including the partitioning of the population, the social network used to represent population interaction and influences, and selected population behaviors. Additionally, the study team modeled the actors that sought to influence the population, the events caused by those actors, essential goods and services, and the infrastructure objects to supply specified goods and services.

This paper outlines a methodology and provides a use case for employing the CG model to produce a scenario, experimental design, and analysis of civilian population in stability operations (See TRAC-MTRY Technical Report [3] for more detailed information regarding the effort).

2. Objective

The study objective was to determine the impact of operations on the populace over time for three specific issues. The three issues considered for this work included security, infrastructure, and governance.

Benefits from the study include:

- Population data in terms of influential groups, narrative identities, beliefs, social network ties, and population distributions across Helmand districts.
- Subject Matter Expert (SME) survey data regarding impact of events on population beliefs.
- Course of Action (COA) analysis that supports Counterinsurgency (COIN) and stability operations in Helmand Province.
- Refinement of the CG model data development methodology, model, and analytical processes.

3. Cultural Geography (CG) Model

The study team utilized the CG model developed by TRAC-MTRY for the Helmand study. The CG model is an ABM of the operational environment based on doctrine and social theory designed to address the behavioral response of civilian populations in conflict environments [4]. The model is patterned after the conflict ecosystem described by Kilcullen [2] in an attempt to capture the complexities of Irregular Warfare.

The CG model consists of entities (people) interacting with each other and responding to specific events. Each entity is defined by a set of demographic dimensions that collectively shape the entity's beliefs, values, interests, stances on issues (i.e. security, infrastructure, governance), and behaviors. The narrative paradigm [4] is the underlying social theory upon which narrative identities are developed to form entity beliefs, values, and interests.

The CG model enables the user to schedule events that impact population beliefs and stances on critical issues through implementation of Bayesian networks for issues. An example of a scheduled event may be insurgents killing a community leader or a Non-Governmental Organization (NGO) providing services. Population behaviors, such as acquiring essential services, may also impact beliefs and issue stances. Finally, population belief may be impacted through communication channels in a social network. The CG model supports representation of a social network by applying concepts of propinquity (physical proximity) and homophily (tendency to associate with those of similar interests). When an entity's belief changes, the entity attempts to communicate the result to other entities within a pre-defined physical distance that possess similar interests. If communication is successful, the receiver's beliefs are impacted accordingly.

4. Study Approach

The study team applied a formal methodology to develop data, build scenarios, execute the model, and conduct analysis in order to represent Helmand Province using the CG model. Data development included defining the area of interest, identifying sources and collecting data, and analyzing data to generate desired output. To support data development, the study team convened an Afghan SME workshop to elicit expert knowledge and opinions on security, infrastructure and governance in the Helmand Province. Specifically, the SME workshop reviewed beliefs derived from the population's narrative identity, established starting conditions for those beliefs based on a 'typical' Helmand resident, and described the impact of events on beliefs for all demographic groups. Scenario development required the study team to identify insurgent groups and other actors in Helmand and their behaviors/events that influence the population's stance on issues. Analysis of model output consisted of SMEs reviewing results from calibration runs, refining experimental factors and levels to focus on significant main effects, and re-executing the model. Findings focus on decision (i.e., controllable) factors and noise (i.e., uncontrollable) factors to support COA analysis for COIN and stability operations.

4.1. Data Development

The study team researched multiple resources to collect data for input to the CG model. Sources included first-hand accounts from Human Terrain Teams (HTT) deployed in theater, Afghanistan SMEs, results from professionally administered surveys (Gallup), interviews with members of Provincial Reconstruction Teams (PRTs), and open source references from Department of Defense (DoD), government agencies, academia, and news organizations.

The study team also reviewed and applied frameworks to assess the status of Helmand Province, to include essential services using the sewage, water, electricity, academics, trash, medical, unemployment, and security considerations (SWEAT-MUS) framework [5] [6]. Additionally, questions to SMEs were developed to understand civil considerations [7] [8] pertaining to

Areas, Structures, Capabilities, Organizations, People, and Events (ASCOPE).

The study team analyzed data to capture required inputs to the CG model. Required inputs include population dimensions and groups, narratives, behaviors, other actor behaviors, key infrastructure, and social networks.

4.1.1. Population Dimensions

The first step in analyzing the data included the identification of potential demographic dimensions from a variety of traceable data sources for the population residing in the six districts of interest. The study team identified five major demographic dimensions and 13 associated demographic groups as depicted in the Table 1. All civilian population entities in the CG model are composed of one demographic group from each demographic dimension. For instance, an entity composition may be 'poor', align with a 'marginalized' tribe, live in a 'rural' location, possess 'moderate' political views, and be of 'military age.' We refer to each distinct composition of dimensions as a stereotype. Dimensions and groups included:

Family Status	Tribe	Disposition	Political Affiliation	Age
Inherited	Pro-Government	Rural	Fundamentalist	Military Age Male
Achieved	Marginalized/ Violent	Urban	Moderate	Spin Giri
Poor/ Unemployed	Passive		Progressive/ Secular	

Table 1. Dimensions and Population Groups.

4.1.2. Beliefs

Narrative identities establish the link between the relevant demographic dimensions and the issues of interest. Specifically, the narrative identity of each dimension provides insight to the population segments beliefs and stance on the selected issues. A narrative identity example follows for the fundamentalist group identified in this study.

> *Fundamentalist groups generally believe in a strictly Islamic state and the literal implementation of Shari'ah (Islamic Law). They are often pro-Taliban and generally believe all foreigners should leave Afghan soil immediately. They strongly oppose the Karzai leadership and opposed the previous Afghan government led by Burhanuddin Rabbani (Tajik). They generally believe women are chattel (property).*

From the narrative identities, the study team extracted beliefs, values, and interests that align with the three issues under study. The beliefs and interests form the conditions for modeling issue stances. Extending the example above, fundamentalist beliefs extracted from the narrative identity include:

- Outsiders not welcome.
- Actively supports the insurgency.
- Distrusts International Security Assistance Force (ISAF) forces.

The study team extracted beliefs for all 13 demographic groups applicable to the issues of security, infrastructure, and governance. For instance, the 'poor' demographic possessed the belief that illegal employment (such as performing insurgent tasks) was merited given the economic challenges within Helmand Province.

4.1.3. Behaviors

The population behaviors modeled for this study were the population's intentions to seek essential services. The CG model simulates population behaviors through Bayesian networks using the Theory of Planned Behavior (TPB). The TPB accounts for an entity's perceived attitude toward the behavior, subjective norm, and perceived behavioral control regarding a specific behavior [9].

Starting conditions for an entity's TPB were determined based on SME input and impacted by success or failure to acquire the essential service. For instance, if an entity successfully seeks electricity, the entity would likely feel more perceived control regarding successfully acquiring electricity in the future. Likewise, success or failure of acquiring an essential service impacts an entity's stance on issues. For instance, successfully acquiring electricity positively impacts beliefs associated with the issues of infrastructure and governance, leading to changes in the entity's issue stance.

Scenario development also required the study team to identify insurgent groups and other actors in Helmand that influence the population's stances on issues through their behaviors. The study team selected five actors of interest to represent in the model: ISAF, Taliban, Government of the Islamic Republic of Afghanistan (GIRoA), NGOs, and Helmand women (to represent the role and influence of females in the population).

The study team defined specific events executed by other actors utilizing input from a deployed analyst in Helmand, Afghan SMEs, and actions by blue and red cell SMEs during a recent tactical war game to determine reasonable events. The actors and their behaviors/events follow:

Actor	Behavior/Event
ISAF	ISAF forces conduct presence patrols.
	ISAF forces conduct raids and takes personnel into custody.
	ISAF forces cordons off a sector and searches for suspects.
	ISAF forces meets with leaders (village, tribal, etc.).
	ISAF forces eradicate opium from the fields.
Taliban	Insurgent groups send threatening letters at night.
	Insurgent groups plant an Improvised Explosive Device (IED) that explodes and kills civilians.
	Insurgent groups kill a community leader.
	Insurgent groups convince civilians to join their forces.
	Insurgent groups provide services (food, water, etc.).
GIRoA	Government representatives provide services (food, water, etc.).
NGO	NGOs provide humanitarian aid (food, water, etc.).
Women	Mothers influence their sons to join insurgent groups.
	Mothers influence their sons to join security forces.

Table 2. Other Actors and Behaviors/Events.

4.1.4. Infrastructure

Modeling the process of seeking essential services, acquiring essential services (or not), and reacting to success or failure of acquiring essential services required the study team to tailor the process to the needs and narratives of the Helmand population and their existing infrastructure. Specifically, the study team:

- Defined and scoped essential services for Helmand.
- Established TPB starting conditions to seek essential services.
- Calibrated the CG model's multi-server queues to represent Helmand capacities.
- Developed case files that simulate reaction to success or failure of acquiring essential services.

Based on discussion with Afghan SMEs, interviews with multiple PRT commanders in Afghanistan, and input from a deployed analyst in Helmand, the study team selected eight essential services to model in the scenarios. These eight essential services are:

- Potable water.
- Farm supplies.
- Medical.
- Legal.
- Irrigation water.
- Transportation.
- Electricity.
- Employment.

Calibration primarily focused on selecting a reasonable capacity for each essential service by district. Each agent was then aligned, by district & stereotype, to appropriate infrastructure & essential service providers.

Developing case files in reaction to success or failure of acquiring essential services required the study team to consider impact on the entity's TPB network and impact on applicable beliefs. Impact on the TPB network generally focused on perceived control and behavior belief. For instance, if an entity successfully acquired irrigation water, then the entity's perceived control of acquiring irrigation water in the future increased, while their attitude (in part based on need) about performing the behavior decreased. When assessing impact to beliefs regarding success or failure of acquiring services, the study team considered the type of essential service and the provider. For instance, an entity successfully acquiring employment with GIRoA changes its belief regarding 'Government Effectiveness' to a more positive stance, leading to a more positive stance on the issue of governance.

4.1.5. Social Network

The study team assessed communications among the 13 population groups to define a rudimentary social network. The matrix defines the strength and likelihood of social ties between the 13 population groups and five other actors. Values in the matrix are from 1 to 9, with 1 being defined as "least likely to communicate" and 9 being "most likely to communicate."

The communication network is asymmetrically parameterized, meaning the order of sender and receiver is significant. For instance, the strength of an Achieved (A) sender communicating with an Unemployed (Un) receiver is '6,' whereas a 'Un' sender communicating with an 'A' receiver is '4.' The reasoning follows that an achieved population group member, assumed to be of higher social and financial status than an unemployed group member, may possess more opportunity to communicate than someone unemployed. Similar reasoning follows for other asymmetric combinations.

This data is used to support the modeling of communications between entities. Specifically, when an entity's issue network or TPB network is impacted by an 'other actor' event or success/failure of acquiring essential services, the entity will attempt to communicate with other entities and pass along the resulting impact. The determination of whether communication occurs is based on entity proximities (propinquity) and strength of social ties (homophily) based on the social network matrix.

4.1.6. SME Workshop

To support data development, the study team convened an Afghan SME workshop to elicit expert knowledge and opinions on security, infrastructure and governance in the Helmand Province. Participants completed a survey designed to capture their input on how a pre-conceived set of events would impact beliefs on security, infrastructure, and governance. Workshop results established starting conditions for beliefs and issue stances, and estimated the impact of future events on entity beliefs. The SMEs also reviewed and confirmed the demographic dimensions and groups, beliefs, and other actor events as reasonable, providing valuable insight to the modeling effort.

The SME workshop also provided data on the relationship between an entity's success or failure of acquiring essential services and the impact of this event on their beliefs. Specifically, entities in the CG model possessed a behavior for each essential service in the model. Success or failure of acquiring an essential service affected three aspects of the entity: (1) its future decision-making regarding acquiring essential services, (2) its belief stances, and (3) its issue stances.

4.2. Scenario

Scenario development was informed by David Kilcullen's description of the conflict ecosystem, where the goal is not necessarily defeat of a single threat entity, but the imposition of stability [2]. As aforementioned in preceding sections, the study team first developed the necessary representation of the population, including the partitioning of the population, the social network used to represent population communication, and relevant population behaviors. Additionally, the study team represented the actors that sought to influence the population, the events those actors caused, essential goods and services, and the infrastructure objects to supply specified goods and services. Completing the scenario required a definition of relevant events that occur at a headline level which can produce an effect or change the functioning of an entity or object, or influence behavior, beliefs, values, interests, and issue stances. For the CG model, the information surrounding the event is as important as the event itself. In brief, the study team defined the possible events, developed methods to implement event outcomes, and developed the information required got the influence of events.

The scenario built was designed to assess the likely effectiveness of specific security forces, government, and NGOs. For this the study team developed six alternatives focused on: increased NGO presence, increased GIRoA capacity, increased social services, combined kinetic and information operations campaign, increased security by ISAF rather than kinetic action, and increased security and information operations campaign by ISAF. In addition, the scenario was designed to assess the impact and the interaction of 14 specific other actor events on the populace over six months. For this the study team implemented experimental design techniques to explore how changes in the input factors affect the simulation output.

Scenarios in the CG model consisted of population entities performing the following actions:

- Consuming essential goods and services,
- Determining whether to seek essential services using the TPB.
- Interacting successfully (or not) to acquire essential services.
- Reacting to success or failure to acquire essential services.
- Communicating successfully (or not) via the social network their success or failure to acquire essential services.
- Reacting to events by other actors.
- Communicating successfully (or not) via the social network their reaction to an event.

Consumption of essential goods & services was a stochastic event tailored to individual entity stereotypes. Determining whether to seek essential services was a stochastic event resulting from the intention node likelihoods in the entity's TPB network. Four parameters in the infrastructure sub-model that impacted success or failure of acquiring essential services were server operating times, server capacity, server transfer rates, and extent of server damage. Reacting to success or failure of acquiring essential services was a deterministic event that results in implementation of case files that impacted the entity's TPB network and applicable beliefs. Communicating with fellow entities the success or failure to acquire essential services depended on proximity to other entities and a stochastic process resulting from

strength of social ties. Successful communication resulted in relaying the same case files.

Reacting to events by other actors was a deterministic process resulting in implementation of case files that impact the entity's applicable beliefs. Communicating with fellow entities the reaction to the event followed the same communication process described above. Successful communication regarding reaction to events resulted in implementation of the same case files impacting the receiver in the same manner as the sender.

The final step of scenario development required the study team to define a baseline scenario and develop alternative scenarios to address notional excursions defined by the study sponsor.

The study team defined the baseline scenario as the 14, described in the Behaviors section, executed at their "low" frequency, for a period of six months of simulation time. A noted limitation to scheduling events in this manner is that actors do not adapt to existing conditions. For instance, the dynamic decision-making process on where to allocate forces based on perceived conditions was not considered for this study.

4.3. Measures of Effectiveness

The purpose of the study was to explore the response of the civilian population over time to specific insurgent, government, security force actions in a stability operations context. The three MOE examined are the population stances on Security, Infrastructure, and Governance of six Helmand districts. These are quantitative measures of the population's perception that indicates the population's issue stance on the issues of analysis. Together they measure the degree positive or negative trend on the population's perception on the three issue stances. These measures of effectiveness

Security is defined whether the population perceives security to be adequate or inadequate. According to numerous research and polling data, security and safety concerns are generally some of the primary causes of instability and are usually focused on the population's confidence on the local police and security forces effectiveness [10]. Insurgent groups pose the greatest threat to security in the form of terrorizing the population, planting improvised explosive devices (IEDs), and deliberate attacks against security forces.

Infrastructure is defined as whether the population is satisfied with the current state of infrastructure and near term prospects, or whether the population believes the current state of infrastructure and the processes for improving infrastructure are unsatisfactory. Polling data suggests that essential services and the supporting infrastructure for essential services is a critical function of government and society [10]. The availability of basic needs such as food, water, healthcare, and employment are for the most part contributing factors to the level of satisfaction among the population. Infrastructure is expressed as the mean population stance on infrastructure of the population modeled.

Governance is defined whether the population perceives existing government structures to be adequate or inadequate. Empirical evidence indicates that views and confidence in the governance, local police, and judicial systems are contributing factors to the level of satisfaction among the population [10]. Governance is expressed as the mean population stance on governance of the population modeled.

4.4. Experimental Design

The CG agent based model provides a means of performing simulation experiments aimed at improving our intuition about the impact of cultural influences on the perceptions and issue stances of the civilian population. In order to derive meaningful conclusions of the data requires a scientific approach to planning the simulation experiments and a systematic framework for analyzing the output data. Statistical design of experiments (DOE) refers to the process of planning the experiment so that the appropriate data will be collected and analyzed by statistical methods, resulting in valid and objective conclusions [11].

This study implemented a two-level fractional factorial design of 16 factors and 32 variations of the scenario (or design points) to explore how changes in the input factors affect the simulation output. In essence, this experimental design technique allowed thorough examination of the output data to identify of linear and nonlinear relationships, as well as interactions without the need to run every conceivable design point.

The factors and their levels were derived from sponsor provided notional scenarios and subject matter expertise. The factors considered that potentially influence populations responses are: ISAF-presence patrols, ISAF-raids, ISAF-cordon and searches, ISAF- leader engagements, ISAF-opium eradication, Taliban-threatening night letters, Taliban- IED, Taliban-kills community leader, Taliban-recruiting, Taliban-provides services, GIRoA-provides services, NGO-provides humanitarian aid, women-communicate join the Taliban, and women-communicate join the ANSF. These factors all potentially influence the population's issue stances and represented typical events and the frequency of those

events occurring in Helmand Province. Additionally, considered other factors namely, time to repair infrastructure and magnitude of damage to infrastructure. Varying these factors allows for examining population responses across a broader range of potential conditions.

Factor	Definition
ISAF-Presence Patrols	ISAF forces conduct presence patrols.
ISAF-Raids	ISAF forces conduct raids and takes personnel into custody.
ISAF-Cordon and Searches	ISAF forces cordons off a sector and searches for suspects.
ISAF-KLE	ISAF forces meets with leaders (village, tribal, etc.).
ISAF-Opium Eradication	ISAF forces eradicate opium from the fields.
Taliban- Threatening Night Letters	Insurgent groups send threatening letters at night.
Taliban- IED	Insurgent groups plant IEDs that explodes and kills civilians.
Taliban-Kills Community Leader	Insurgent groups kill a community leader.
Taliban-Recruiting	Insurgent groups convince civilians to join their forces.
Taliban-Provides Services	Insurgent groups provide services (food, water, etc.).
GIRoA-Provides Services	Government representatives provide services (food, water, etc.).
NGO-Provides Humanitarian Aid	NGOs provide humanitarian aid (food, water, etc.).
Women-Communicate Join The Taliban	Mothers influence their sons to join insurgent groups.
Women-Communicate Join The ANSF	Mothers influence their sons to join security forces.

Table 3. Summary Definitions of Factors.

This case study used a high performance computing cluster to produce the scenario production runs. The experiment involved 30 replications for each of the 32 variations of the scenario for a total of 960 runs. The model starts with entities consuming, seeking essential services, reacting to scripted events by other actors, and interacting with other entities, and simulates until all the scripted events have been executed.

5. Results

Upon completion of the simulation experiments, the study team reduced and aggregated the simulation output to show the change in issue stance over time for each of the six districts for each of the 52 population stereotypes and each of the five demographic dimensions.

The study team applied multiple tools, methods, and procedures to explore and maximize insight into the data set. Graphical analysis, multiple regression, and Classification and Regression Tree (CART) analysis techniques were performed to analyze model output, extract significant factors, and detect outliers and their potential impact on subsequent analysis. Furthermore, the study team applied these techniques to develop parsimonious models and determined favorable factor settings. CART and graphical analysis were also applied to confirm the validity of model behavior and gain insights about significant factors influencing further analysis.

As previously discussed, the three primary MOEs were the population stances on security, infrastructure, and governance in Helmand Province. Inputs affecting these measures include events from other actors (introduced through experimental design factors in the scenarios), interaction with the CG model's infrastructure sub-model, and interactions across a social network. Findings presented below are based on trends in the output and magnitude of results relative to other scenarios, and should not be interpreted as predictive.

Exemplar findings based on analysis of the scenarios by district and population group include:

- The most significant positive impact on the population's perception of security, infrastructure, and governance was directly related to the amount of ISAF non-kinetic operations.
- Scenarios that involve an increase in kinetic operations (initiated by either ISAF or an insurgent group) negatively impact the security stance for all population groups.
- GIRoA or NGOs providing services improves the perception of governance in comparison to when ISAF provides these services unilaterally.
- Political and tribal affiliations, namely political fundamentalist and marginalized/violent tribes achieved the lowest perception of security and governance. These groups generally distrust ISAF forces, do not welcome or accept outsiders, and believe that the government is ineffective or irrelevant. These beliefs contributed to low perceptions.
- Scenarios that involve providing services through GIRoA or NGOs positively affect the population's perception of infrastructure.

- Family status namely, unemployed/poor achieved the lowest perception of infrastructure. The unemployed/poor generally believe that the government should provide infrastructure, are more tolerant of illicit commerce, and may be more willing to accept illegal/illicit jobs. These beliefs contributed to low perceptions.

Insights from the overall results show that the Helmand population is diverse across socio-cultural dimensions, leading to varying reactions to the events in the alternative scenarios. Notably, increased frequency of ISAF presence patrols had the most positive effect (from an ISAF perspective) on the perception of security, infrastructure, and governance when compared to the baseline scenario. Additionally, an increase in the frequency of either NGO services or GIRoA services resulted in a more positive perception of security, infrastructure, and governance but was most noticeable when both NGO and GIRoA services were increased. Conversely, increased ISAF kinetic events, such as raids and cordon and searches, had a slightly negative impact on the perception of security and infrastructure.

6. Way Ahead

The study team has proposed to further develop the model and scenario in support of current operations, expanding the analysis to 29 districts. In addition to data development efforts, the team is planning to implement several model enhancements during 2010:

- Dynamic social networks. Currently, the social network is developed through baseline homophily, the demographic similarities between agents. A dynamic social network will change according to the similarity of beliefs and issue stances.

- Agent interpretation and behavior selection. Currently, agent behaviors are dictated based on a limited representation of the TPB with few dynamic inputs. Social network input for norms, along with better representations of cost, need, and perceived control will result in improved behavioral representation.

- Infrastructure improvements. Greater flexibility in specifying and modifying service parameters will enable scenarios to explicitly use more real-world data to generate more realistic representations of service conditions.

- Quantification of persuasion and influence. Messages of the same type have the same impact on beliefs and issue stances, regardless of the sender. Including factors such as status will greatly improve the fidelity of the social network.

- Politics and corruption. Corruption must be understood within a cultural context; as many different societies have the concept of corruption; their perception of the phenomenology varies greatly.

- Economics and corruption. Corruption has clear implication for the performance and efficacy of an economic system; quantifying the effects of corruption is essential to adequately represent the economic components of the model.

- Geospatial representation of agents, events and infrastructure. Although there is a rudimentary representation of locations, agents are static and there is a low significance of event and infrastructure location. As we enhance the geospatial representation, the location of agents with respect to events, infrastructure and the social network will be both more meaningful, and informative.

7. Summary

This research explores the use of an ABM with social science underpinnings in support of current operations. Of particular interest is the evaluation of the civilian population in stability operations.

The primary findings and insights derived from the analysis are summarized below with disclaimer that, as with every model, the results are dependent on the input, the scope, and the assumptions.

Modeling the affects of various scenarios on the population in Helmand provides a means to evaluate courses of action.

A multi-faceted approach to operations in Helmand Province, based on the district, political affiliation, family status, and tribal affiliation will have the greatest positive impact.

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Disclaimer

Findings are not to be construed as an official Department of the Army (DA) position unless so designated by other authorized documents.

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